

CO2 Dragster

Objectives:

- Students will use problem-solving skills to design and build a CO² Dragster.
- Students will follow safety rules for hand and power tools while working in the Production Lab.

Introduction

One of the most important considerations when designing a vehicle is aerodynamics. Aerodynamics involves how air flows past an object or how an object moves through air. The more aerodynamic a vehicle is the better your car will move through the air. We will test the aerodynamics of your car with the wind tunnel. In the wind tunnel we can see and measure how the air flows around the shape of your car. This flow of air is called streamline. A car body with an overall rounded or square shape will cause the air to stray from the streamline causing swirls of air. This turbulent air movement, called drag, will slow down the vehicle.

In this activity, you will design, construct, and test an aerodynamic vehicle. A CO₂ cartridge will then power your car. Make sure you take your time and follow the limitations while building your dragster. It will have a better chance of looking good and going fast.

Problem

You are an automotive design engineer for the PCMS Automotive Company. You have been asked to design a vehicle (using the limitations at the bottom of this page) that is aerodynamic, fuel efficient, and stylish. You will be in charge of the designing, constructing, and testing of the new vehicle. All the cars in the company will be compared for excellence in design, craftsmanship, aerodynamics, and the fastest racing time.

Materials/Supplies

- 1/4" graph paper
- masking tape
- sandpaper
- soda straw
- 2 axles
- 4 washers
- 1 body blank
- 2 rear wheels
- 2 front wheels
- 2 1/8" screw eyes
- CO2 cartridges for race

Tools/Equipment

- drawing tools
- scissors
- wood rasp/file
- band saw/scroll saw
- sander
- wind tunnel
- drill press



Blue Devils

Problem Solving

I. Read and Understand the Problem

What am I being asked to do?
What information will I need?
What tools might I use?



II. Devise a Plan

Do I need any information that was not given?
How will I find the information?
How should I use the information?



III. Carry out the Plan

Do what you said you would do.



IV. Check Back

Does my solution seem reasonable?
If not, what strategy should I try next?
How can I check my work?

Problem Solved!!!



Step by Step

- **Step 1: Thumbnail Sketches** - Thumbnail sketches are little. Be Creative. Don't be afraid to experiment with some strange designs. They do not have to have much detail. They are just quick sketches that give you ideas (brainstorm). Develop 16 Thumbnail Sketches.

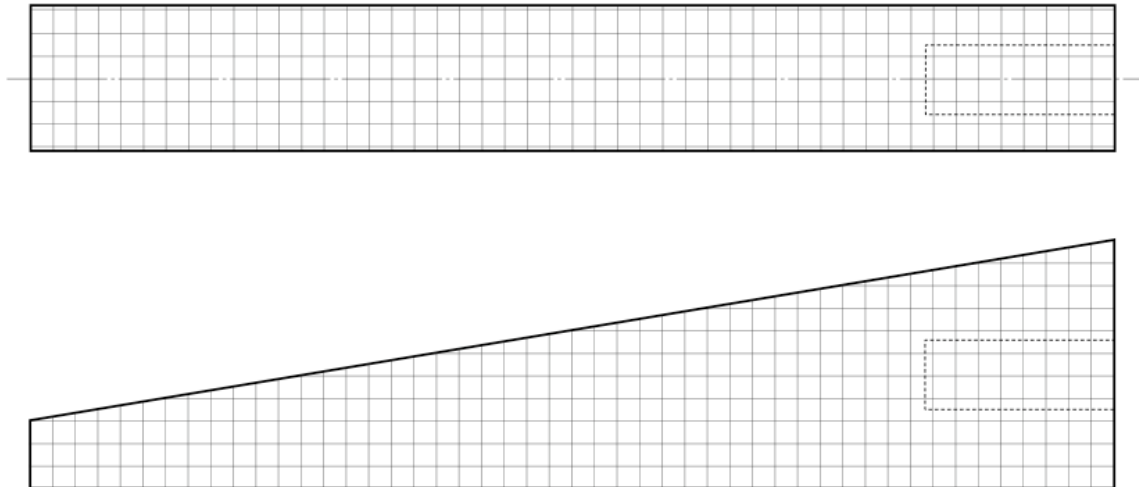
1.	2.	3.	4.
5.	6.	7.	8.
9.	10.	11.	12.
13.	14.	15.	16.

F E E D B A C K

Good	___ High quality work	___ Good effort	___ 16 good ideas	Improve	___ Some poor ideas	___ Sloppy work	Did not follow ___ Directions
	___ Creative or original	___ Shows thought	Followed ___ Directions		___ Many similar ideas	___ Need more effort	___ Late/incomplete

- **Step 2: Rough Sketches** - Develop 4 rough sketches. Each set of rough sketches must have a top and side view of the thumbnail you have chosen. Lightly draw your designs in the boxes below. When you are satisfied with the outline of your car, darken the lines. Finally, lightly shade in the design adding any paint designs you may wish to add.

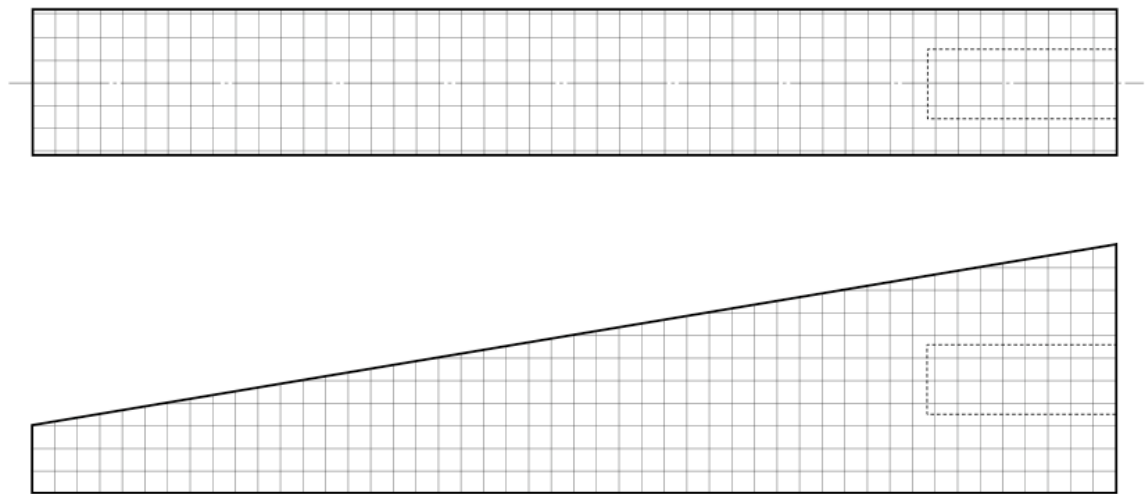
Design One



F E E D B A C K

Good	___ Meets design criteria	___ High quality work	___ Top/Side line up	Improve	___ Does not meet criteria	___ Sloppy work	___ Did not follow Directions
	___ Good line quality	___ Creative/Original	___ Followed directions		___ Measurement errors	___ Views don't line-up	___ Late/incomplete

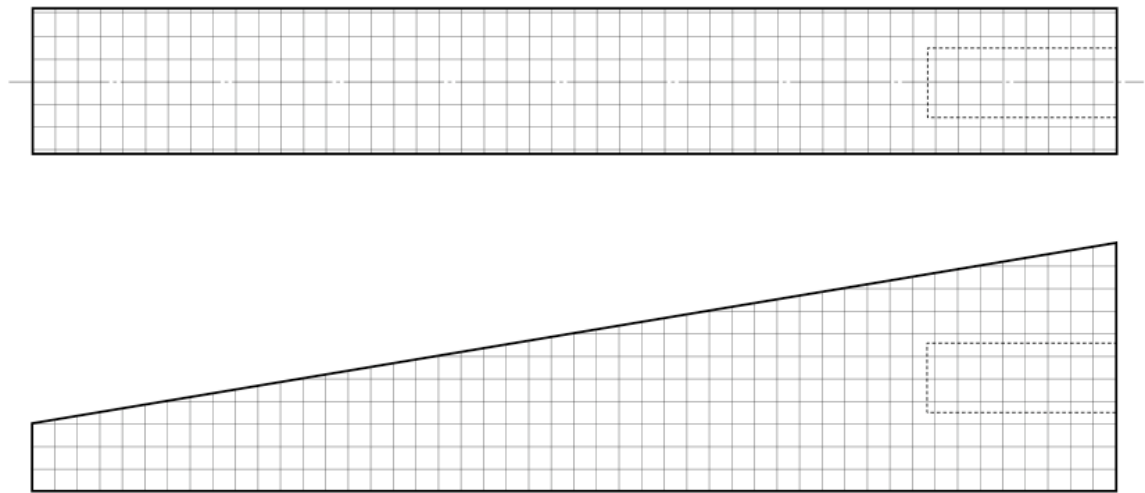
Design Two



F E E D B A C K

Good	___ Meets design criteria	___ High quality work	___ Top/Side line up	Improve	___ Does not meet criteria	___ Sloppy work	___ Did not follow Directions
	___ Good line quality	___ Creative/Original	___ Followed directions		___ Measurement errors	___ Views don't line-up	___ Late/incomplete

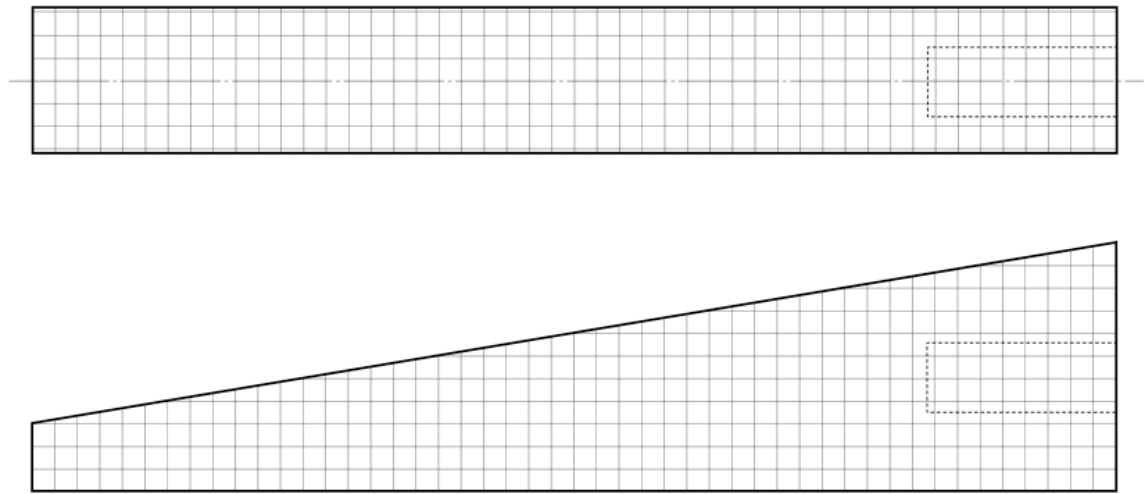
Design Three



F E E D B A C K

Good	___ Meets design criteria	___ High quality work	___ Top/Side line up	Improve	___ Does not meet criteria	___ Sloppy work	___ Did not follow Directions
	___ Good line quality	___ Creative/Original	___ Followed directions		___ Measurement errors	___ Views don't line-up	___ Late/incomplete

Design Four



F E E D B A C K

Good	___ Meets design criteria	___ High quality work	___ Top/Side line up	Improve	___ Does not meet criteria	___ Sloppy work	___ Did not follow Directions
	___ Good line quality	___ Creative/Original	___ Followed directions		___ Measurement errors	___ Views don't line-up	___ Late/incomplete

- **Step 3: Working Drawings** - Decide which of the four sets of rough drawings you like best. Show it to other students in your class. Discuss your idea with them. Make sure your design does not have a flaw that will disqualify you from competing. After you have discussed your design. Draw your design accurately on 1/4" graph paper supplied by your teacher. These drawings must not be rushed. Follow all the measurements listed below.

Factors	Maximum	Minimum
Axles (Diameter)	3mm	3mm
Axles (Length)	70mm	42mm
Axle Bearing Diameter (Diameter)	4.5mm	3.5mm
Axle Hole (Diameter)	4.5mm	3.5mm
Axle Hole (Position from either end of the body)	100mm	9mm
Axle Hole (Position above body bottom)	9mm	3.5mm
Brass Spacer (Diameter)	9mm	7mm
Dragster Body (Length)	305mm	200mm
Dragster Body (Height at rear wheels)	75mm	56mm
Dragster Body (Mass with wheels)	170.10g	30g
Dragster Body (Width at wheels front and back)	42mm	35mm
Power plant depth of hole	51mm	51mm
Power plant housing thickness (Around entire housing)		3mm
Power plant Housing (Diameter)	20mm	19mm
Power plant C/L (From body bottom)	35mm	31mm
Screw eye (Eyelet inside diameter)	5mm	3mm
Screw Eyes (2) on C/L of bottom, distance apart	270mm	155mm
Wheels, Front (Diameter)	37mm	32mm
Wheels, Front (Width of greatest diameter)	5mm	2mm
Wheels, Rear (Diameter)	40mm	30mm
Wheels, Rear (Width of greatest diameter)	18mm	15mm
Wheelbase	270mm	105mm

Technology Students Association (TSA). TSA Metric 500 Dragster Specifications.

Step 4: Drilling Axle Holes -

1. Cut out the top and side view templates using a scissors.
2. Tape the side view to the body blank given to you by your teacher.
3. Using a 11/64" drill bit. Drill your axle holes using the drill press. (Following Safety rules.)

Step 5: Cutting - (Follow all Safety Rules)

Side View - Use the band saw to cut out the side view of your drawing. Make sure you get permission to use the band saw before you start to cut. Take your time. Make sure you cut on the waste side of your line. If you make a mistake your car will surely change. Any such change may disqualify you from racing.

Top View - Use the band saw to cut out the top view of your drawing. Once again, take your time. Make sure you cut on the waste side of your line. If you make a mistake your car will surely change. Any such change may disqualify you from racing.

Step 6: Shaping - Carefully use a rasp, wood file and sandpaper to round and smooth your dragster. This is one of the most important steps. Take your time. Hollowing out the body can be done in a number of ways. A drill can be used to drill various sized holes from the bottom of the car. A chisel can be used to remove the wood that is unwanted. Begin by working the rough spots with rasps and files gently, then smooth with sandpaper. The body blank will sand fairly smooth. Take your time and remember that craftsmanship here will pay big dividends in the race.

Step 7: Painting - Place a 3/4" dowel rod, 12-18" long, into the CO2 hole to use as a handle. Now you can begin to paint following the steps below with out painting your hand. (Not required to be painted to race in class competition.)

1. Prime the car using a good quality wood primer. Take time to put on a thin coat instead of a thick messy coat. Remember to wash you brush out when finished. Allow the primer to dry overnight, lightly sand away the imperfections with fine sandpaper. The object here is to sand the primer smooth, not sand the primer off.
2. To achieve a quality paint job, remember to always keep the nozzle at least 8" away from your car body, use short bursts of paint, and always keep the spray can in motion. Doing these three things will avoid most runs and drips. Start with an overall color, then add accent colors. Remember, four light coats are better than one heavy coat, and will dry much faster. With care and thin coats, you should be able to achieve a high gloss, low drag finish of 8-10 coats in a couple of nights.

Step 8: Wheels and Screw Eyes - Follow the instructions of the teacher as we assemble the wheels and put the screw eyes on during class when everyone is ready.

Step 9: Testing - Weigh your CO2 car with the triple beam balance and test lift and drag in the wind tunnel.

CO² Dragster Grading Rubric

Overall Dragster, 25 points total	NO	Maybe	Yes
Engineering principle of mass has been considered	1	3	5
Engineering principle of friction has been considered	1	3	5
Engineering principle of drag has been considered	1	3	5
Design involves advanced ideas, construction, or detail	1	3	5
Design is thoughtful, not haphazard or block-like	1	3	5
Body, 15 points total	NO	Maybe	Yes
Body meets minimum and maximums	1	3	5
Body is free of structurally weak area	1	3	5
Body is free of flaws	1	3	5
Finish, 15 points total	NO	Maybe	Yes
Preparation for painting was done properly	1	3	5
Overall finish is defect free	1	3	5
Special details (multi-color, decals, painting hubs) included	1	3	5
Craftsmanship and Quality, 15 points total	NO	Maybe	Yes
Finished project maintains original design	1	3	5
Attention to detail is evident	1	3	5
Project was completed in a timely manner	1	3	5
Average race time, 25 points total	NO	Maybe	Yes
<1.05			25
1.06 – 1.10			24
1.11 – 1.15			23
1.16 – 1.20			22
1.21 – 1.30			20
1.31 – 1.40			18
1.41 – 1.50			16
1.51- 14			14